Science Observations: Fossil Questions & Answers

What is a fossil? ... *Fossils are evidence of past life, preserved by a geologic process.* Generally these geologic preservation processes take a long time, though some fossils have been found that are just several hundred years old. Some examples of fossils include a petrified (turned to stone) skull of a rodent, a seashell mold in stone, a carbon residue image of a leaf in stone, a canine's paw-print in rock, a stone cast of a beaver's burrow, and a frozen (intact) wooly mammoth in an ancient glacier.

What is the study of fossils called? ... The study of fossils is called paleontology. Paleontology is a branch of geology and biology. It is the science that deals with the history of the earth and its life as recorded in rocks. To understand how plants and animals lived in the past, one should learn about how they live now, so a paleontologist is also part biologist.

Where are fossils found? ... Fossils are found world-wide, from ocean deposits to the highest slopes of mountains, from Antarctica to the Sahara Desert. The type of sediments the organism was buried in is a key factor in the likelihood of fossils being present in any number. A key step in an organisms remains becoming a fossil is rapid burial by sediments. A land area in a period of erosion, rather than land building (heavy sedimentation), reduces the chances of fossilization. Each fossil site is different, in the types and numbers of fossil organisms found and how well they were fossilized. If you have seen one fossil park you have not seen them all.

How do fossils occur? (excerpts from, Prehistory, by Giovanni Pinna) ... The death of an organism is followed by complex fossilization processes (chemical, physical and biological). These processes maintain organisms in various degrees of preservation through time. When studying fossils it is always important to discover whether the fossil in question used to live in the place where it has been found or whether it was transported. "Post-mortem transportation" is very common, leading to organisms fossilizing in areas different from those in which they lived. Movement of remains can be caused by many factors; sea currents can move remains, floods move remains, scavengers can drag remains for short distances.

Disintegration processes may be the next fossilization phase. They act at different speeds on various organic parts of the remains. This disintegration can be due to three types of factors: biological, mechanical and chemical. Destructive biological agents, such as decomposing bacteria, generally affect the soft parts of an organism first. If the soft parts are to be preserved a rapid and thick sedimentation must take place and cover the organic remains before they are completely decomposed. Even shallow layers of deposits contain bacteria and allow decomposition. Other destructive biological agents include burrowing animals and scavengers.

Mechanical destruction can be caused by currents, waves, wind and other factors that produce abrasion and corrosion of an organism, sometimes destroying it completely. The combined action of destructive biological and mechanical agents is such that, more often than not, fossils are found to be incomplete, broken and scattered over a wide area.

Chemical dissolution is more destructive to an organism's soft parts, which are made up of carbohydrates and proteins. It has less effect on the hard parts, composed of calcium carbonate, calcium phosphate, silica, or highly resistant organic substances such as chitin, keratin, and cellulose. Chemical change plays an important role, since it can continue to affect the organism even after they are already fossilized. Even within the same organism, certain parts are found to have fossilized and others to have vanished, since different structures react quite differently to chemical corrosion. In mammals, for instance, teeth are more easily preserved than bones. They are more resistant to dissolution.

Finally, a lot depends on the type of sediment which has surrounded the organism. Generally speaking, coarse sediments (such as sand, conglomerates and gravel, easily infiltrated by water) do not lead to a good preservation of organisms. Fossils are rarely found in such rocks. On the other hand, clays, marl (high in calcium) and all impermeable sediments, primarily fine-grained, are better suited to give the necessary protection and are therefore found to be rich in fossils.

Water, rich in dissolved mineral salts, circulates in sediments. It can affect organisms embedded in the sediments in two ways: they tend to dissolve the organic remains, while at the same time they impregnate the organism with mineral substances, thus stabilizing it and preserving it. The slower the water circulation the better chance of an organism being saturated with minerals and preserved, called mineralization or petrification. The substitution of organic matter with inorganic mineral substances can be total, such that all the hollows in an organism which had organic matter are filled by minerals. A more interesting process is molecular substitution. It consists of the substitution of each and every organic molecule, and can preserve minute details of organisms. An example of this process is fossilized wood which still shows the growth rings.

Under certain conditions, or due to an unusual combination of factors, organisms have been preserved as fossils in very unusual ways. Common in rocks are molds, imprints, and casts of organisms, whose remains have dissolved away with time. Carbonized fossils, affecting mainly plants, are due to the action of certain bacteria which attack the plant remains, eliminate oxygen and nitrogen and indirectly add carbon. Though the plant material is gone the carbon residue remains, leaving dark images in the rock of the parent organism. Tree resin can trap and preserve intact small insects, the resin polymerizing into amber over time. Rare cases of mummification result in fossils having undergone a thorough dehydration process. This can result in the total conservation of even the most delicate parts, such skin and tendons. Also ancient glaciers have trapped and frozen organisms, intact. Though there are many different types of fossils, finding mixtures of these types in the same earth strata would be extraordinary.

What assumptions do we make when we study earth's history? (excerpts from, Evolution of the Earth, by Robert H. Dott, Jr., and Donald R. Prothero) ... The idea of some sort of uniformity in nature through time is absolutely basic to the analysis of earth history. Modern geology sees the earth as evolutionary and having changed through an irreversible, or evolutionary, chain of cumulative events. The only assumption that we make today is that *the principles of nature have been uniform through time*. We hasten to stress that this uniformity is an assumption that we make about nature and so is a *doctrine* rather than a logically proven law.

We do not assume that the current geological processes (this is different from a principle) always acted with the same rates and intensities. Floods, erosion, volcanic eruptions, mountain uplifting, wind and seas currents, continental drift, all occur with varying rates and intensities. Another way of stating the principle of uniformity is that "the present is the key to the past." Paleontologists also utilize the principle somewhat in reverse.

Future predictions may be possible from observations about the past. This concept has been cited as the basis for the study of history in general. We may be able to predict the future of modern lifeforms by studying the fossil record. As Mark Twain wrote, "The past may not repeat itself, but it does rhyme."

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